Application Note

Measurement of Circadian Gas Exchange Dynamics in *Arabidopsis thaliana*

Dr. Alex Webb and Dr. Antony Dodd (Cambridge University (UK), Department of Plant Sciences) and PP Systems have developed a unique gas exchange system for use with *Arabidopsis*. The custom system is being used as part of a program to dissect the architecture of the signal transduction networks that regulate circadian rhythms of stomatal aperture and photosynthesis. Since this is being addressed using a range of molecular genetic tools, the system has been designed with a multi-cuvette configuration to enable long term, side-by-side comparisons of several transgenic lines. The "Arabidopsis System" has been designed to provide a low-cost, multi-cuvette solution by combining a single CIRAS-1 portable, differential CO_2/H_2O IRGA with gas switching and humidity control systems. The unique cuvette design allows a whole-plant configuration, to prevent fragile leaf tissues from becoming damaged during gas exchange sessions lasting up to 10 days. This is combined with cuvette environmental control systems that provide simultaneous, tight control of relative humidity and CO_2 within each gas exchange cuvette. Configuration and data collection is accomplished using PC-based software. However, the system incorporates dual control from both PC-based software and custom software within the CIRAS-1, which provides a failsafe mechanism to ensure that data remains secure in the event of communication errors.

Close-up view of CIRAS-1 gas analyzer, gas switching unit and environmental control system.

Arabidopsis Cuvette

The whole plant cuvette is designed so that plants are grown in small plant pots filled with soil or other solid medium. The plant pot is sealed and secured into the base of the cuvette. Gas exchange between the soil and cuvette is prevented by covering the soil surface with two layers of polythene, and placing the cuvette under moderate positive pressure. Plants continue to receive water from below whilst in the cuvette. Experiments have shown that data can be collected from plants, with no evidence of stress, for up to two weeks using this cuvette design.

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